

Space Weather Technical Forecast

Issued on Monday 17 February 2025 at 00:17 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: M-flares likely. Chance of G1/Minor storms Day 1 (17 Feb). Active electron fluence likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is currently Low, with the peak flare C6.4 at 16/1838 UTC, likely from AR3998.

There are currently twelve sunspot regions on the visible disc. The three regions of most interest are AR3990 near south centre disc and perhaps AR3996 and AR3998 in the southeast. AR3990 consists of a large central spot surrounded by small peripheral spots, but with some minor magnetic complexity. AR3996 is rotating into a better view, but so far appears to be relatively straightforward with any apparent complexity likely due to lingering foreshortening of the view near the limb. Oncoming regions AR3998 in the southeast and AR3999 in the northeast are both showing apparent growth, although some of this could be due to them rotating into a better view. AR3998 in particular is difficult to fully assess due to its proximity to the limb. AR3992 in the southwest is also becoming more difficult to assess as it approaches the limb. All other spots appear relatively simple at the present time.

No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE and DSCOVR at L1, showed a waning connection to a fast wind from CH15/-. Wind speeds were elevated to strong, initially near 600 km/s but slowly declining to around 520 km/s. Density was generally near or below average. The Interplanetary Magnetic Field remained weak throughout, at 6nT or below. The north-south component was also weak and variable, between +6/-5nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at background levels.

High energy electron flux (greater than 2MeV) at GOES16 reached high levels at the diurnal maximum, peaking at 3930pfu at 16/1640UTC. The associated 24-hour fluence rose above the Active threshold (1e8 integrated pfu), with the 17/0000UTC observation being 1.19e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate, with isolated M-class flares likely.

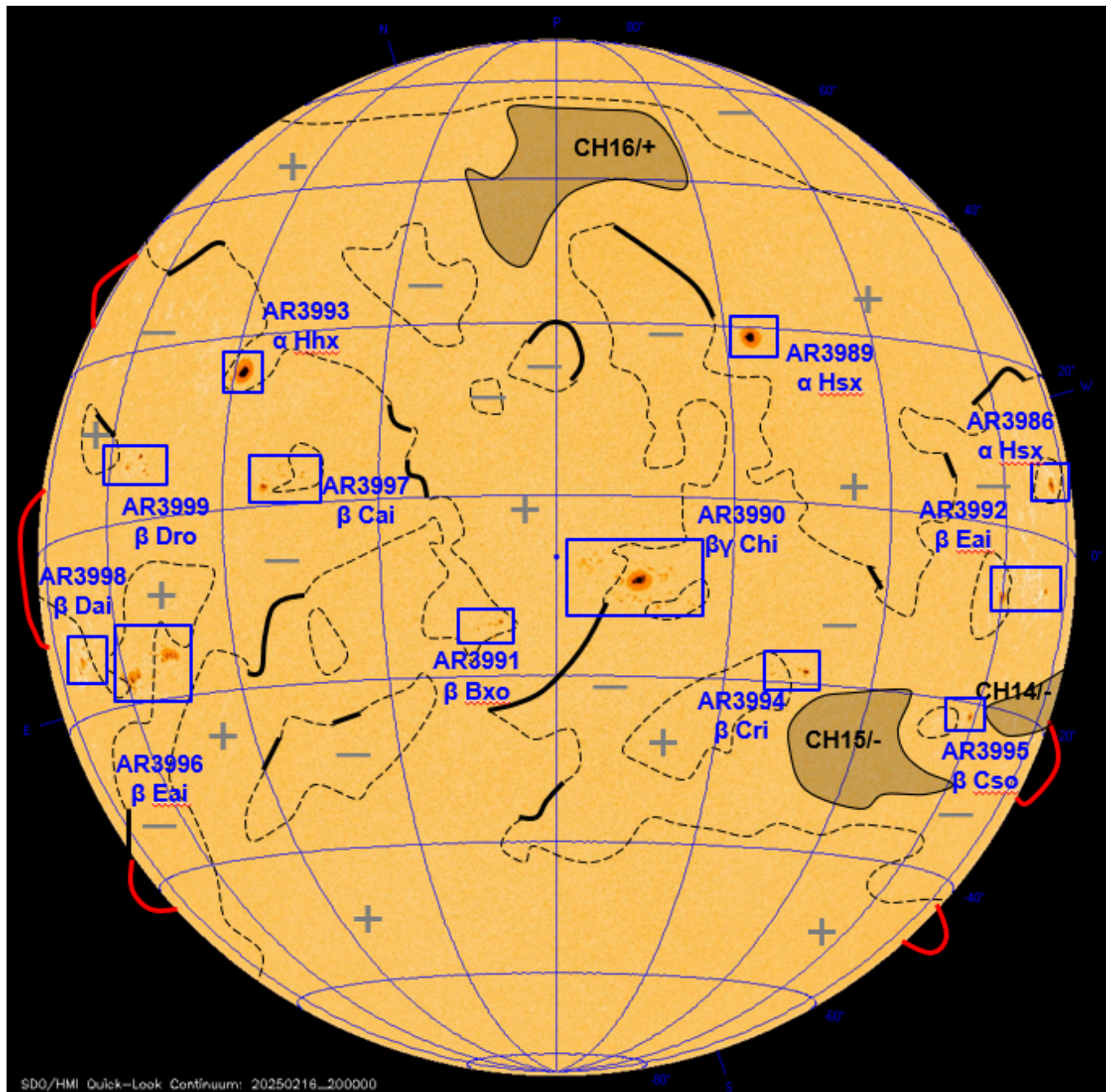
Solar Wind / Geomagnetic Activity: Several CMEs were observed leaving the Sun on February 14th and 15th. Confidence in all of these CMEs remains low, but there is a chance of glancing impacts between Days 1-3 (Feb 17–19). However, it is considered much more likely that these features will miss behind Earth's orbit. Coronal hole fast winds are starting to wane, and are expected to continue to decline through this period, likely to near background levels by Day 4 (20 Feb).

Predominantly Unsettled to Active geomagnetic conditions are expected at first, with a chance of G1/Minor geomagnetic storm (Kp 5) intervals due to coronal hole influence or perhaps glancing CMEs. As wind speeds ease, so geomagnetic activity is expected to wane, with just a slight chance of any CME influence increasing geomagnetic activity again.

Energetic Particles / Solar Radiation: High energy proton flux is likely to persist at background levels, with a marginally increasing slight chance of rising above the S1/Minor radiation storm threshold, as the current active regions move west.

The high energy electron flux is expected to continue to reach high levels at the diurnal peaks, with the fluence now above the Active (1e8 integrated pfu) threshold and likely to stay that way through the period.

Figure 1: Solar synoptic map, valid 16/2000 UTC.



Key: Filament __, Prominence __, Magnetic Field Line ---, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms

Several CMEs were observed leaving the Sun on February 14th and 15th, mostly originating from AR3990 or AR3994, and from a filament eruption. Confidence in all of these CMEs remains low due to the absence of clear dimming in imagery and the influence of nearby coronal hole fast winds, likely pushing any CMEs eastwards behind Earth's orbit. As a result, there is a chance of glancing impacts between Days 1-3 (Feb 17-19), but overall it is considered much more likely that these features will miss behind Earth.

Coronal hole fast winds from CH15/- continue, but are starting to wane. Solar wind speeds are expected to continue to decline through this period, likely to near background levels by Day 4 (20 Feb). This forecast is broadly supported by MOSWOC Enlil.

Predominantly Unsettled to Active geomagnetic conditions are expected at first, with a chance of G1/Minor geomagnetic storm (Kp 5) intervals due to coronal hole influence or perhaps glancing CMEs. As wind speeds ease, so geomagnetic activity is expected to wane, with just a slight chance of any CME influence increasing geomagnetic activity again.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	30	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil, showing a gradual decline in wind speeds over the next few days.

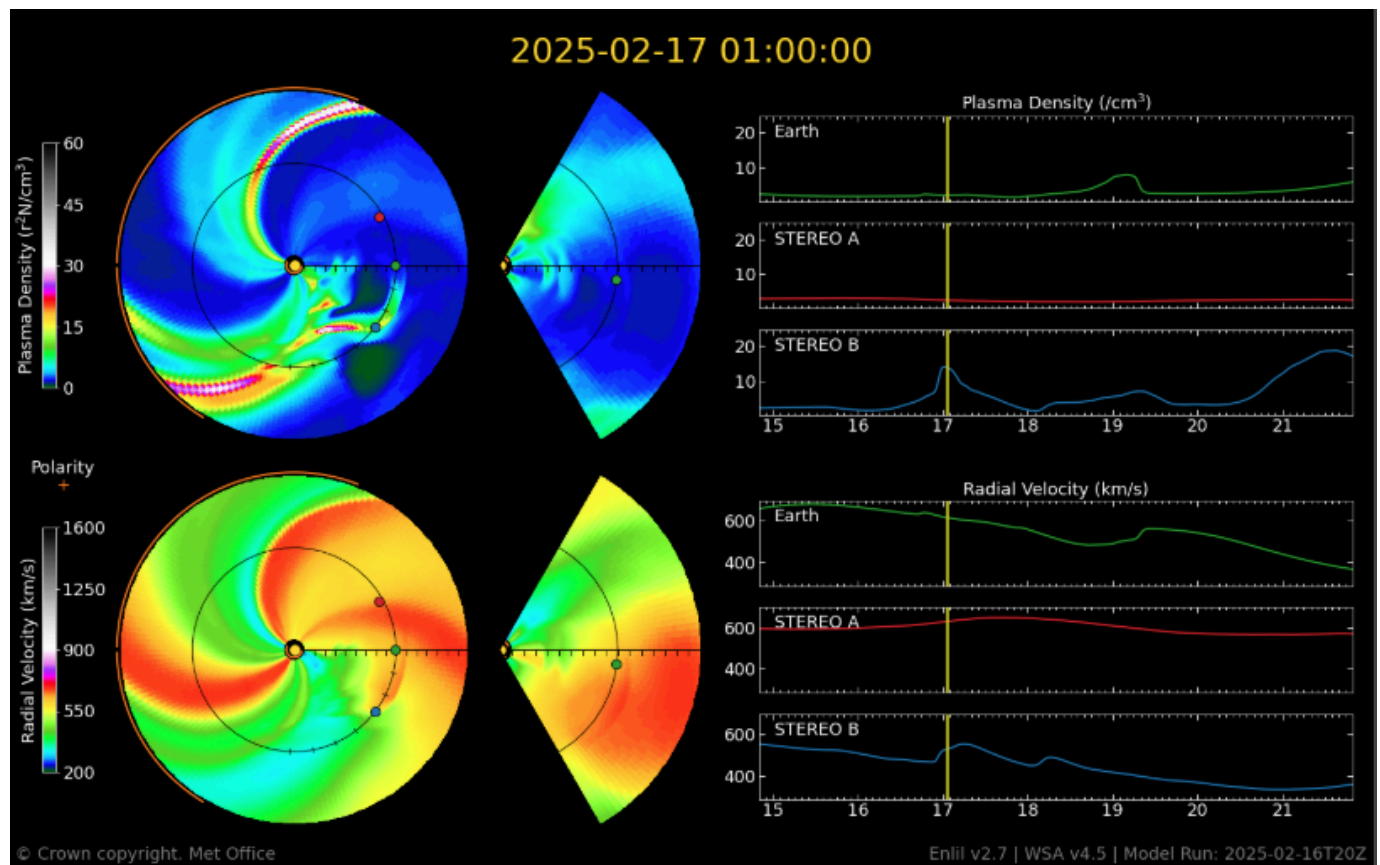
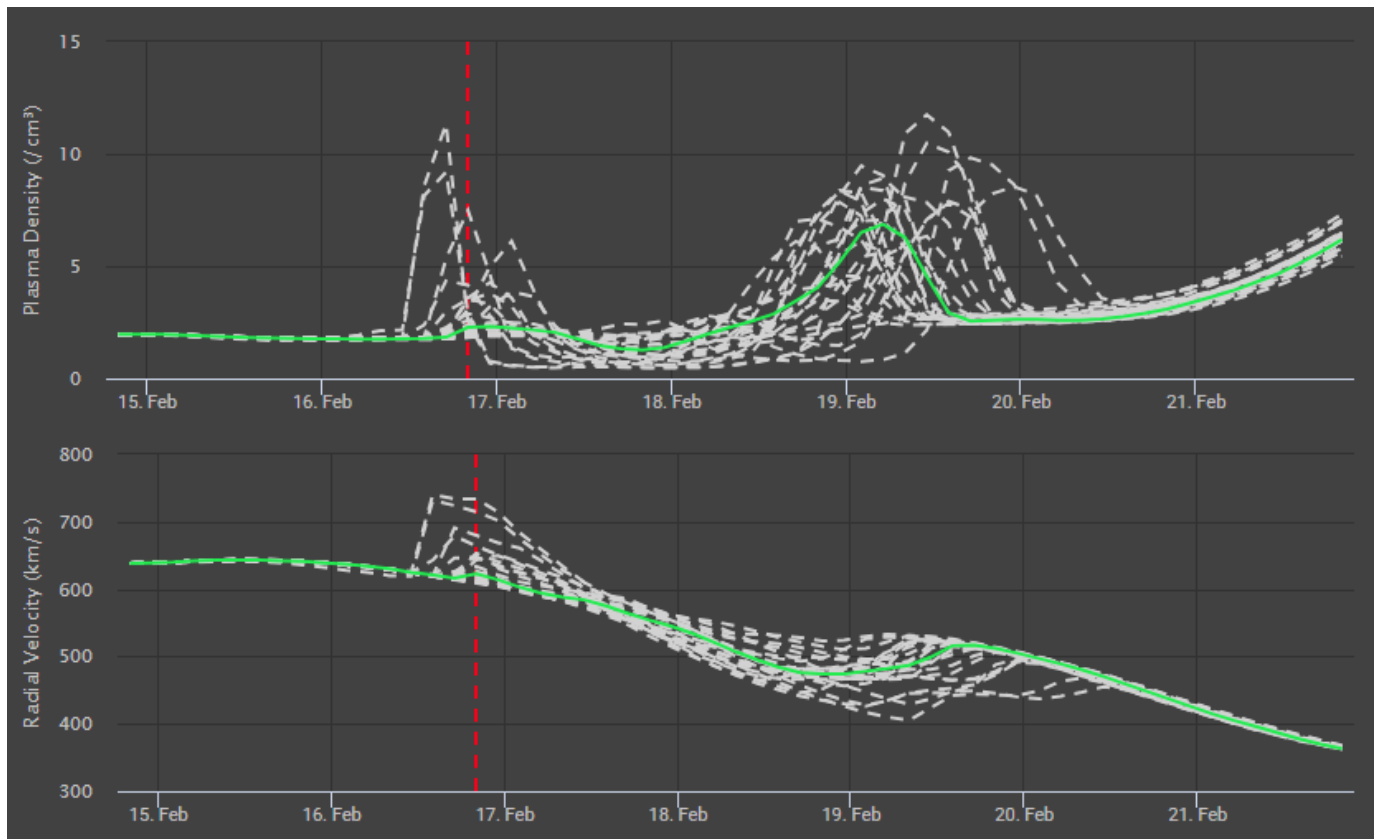


Figure 3: Enlil ensemble, showing the risk of CME glancing blows over the next few days.



Radio Blackouts - X-Ray Flares

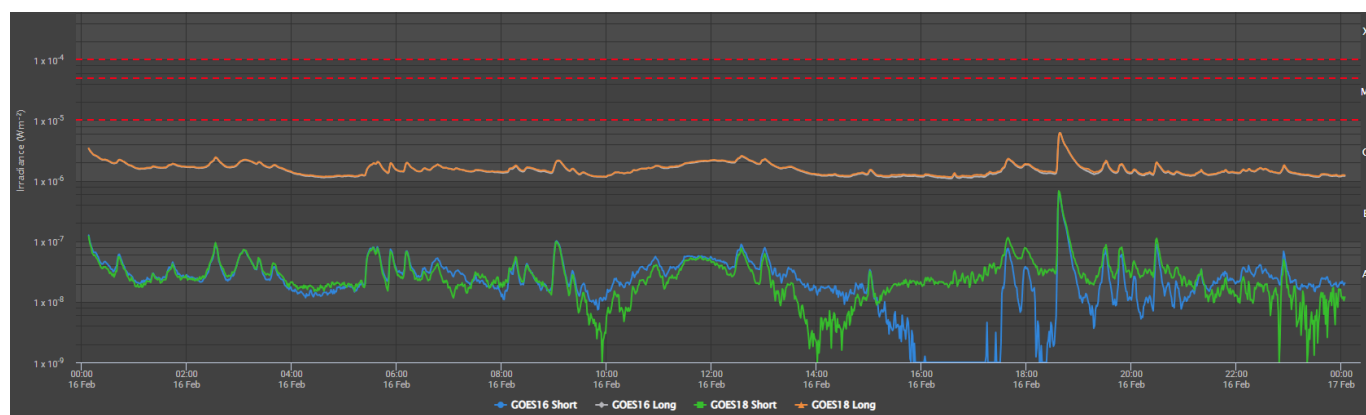
Solar activity is currently Low, with a peak flare C6.4 at 16/1838 UTC, likely from AR3998 in the southeast.

There are currently twelve sunspot regions on the visible disc. The three regions of most interest are AR3990 near south centre disc and perhaps AR3996 and AR3998 in the southeast. AR3990 consists of a large central spot surrounded by small peripheral spots, but with some minor magnetic complexity. AR3996 is rotating into a better view, but so far appears to be relatively straightforward with any apparent complexity likely due to lingering foreshortening of the view near the limb. Oncoming regions AR3998 in the southeast and AR3999 in the northeast are both showing apparent growth, although some of this could be due to them rotating into a better view. AR3998 in particular is difficult to fully assess due to its proximity to the limb. AR3992 in the southwest is also becoming more difficult to assess as it approaches the limb. AR3994 in the southwest quadrant is a small and apparently unremarkable region, yet it was the source of a number of flares and perhaps faint CMEs on 14 Feb. All other spots appear relatively simple at the present time.

Activity is forecast to be Low to Moderate, with isolated M-class flares likely.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability		(Yes/No)	(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: X-ray flux at GOES16 and 18, with only C-class flares in the last 24 hours.



Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is most likely to persist at background levels, but with a slowly increasing slight chance of enhancement above the S1/Minor radiation storm threshold. This is mainly due to the potential for flaring from AR3990 as it rotates further into the better connected western hemisphere, but also with some component from AR3996 and AR3998 rotating towards centre disc.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	5	5	10	10
Very Active	$\geq \text{S3}^*$	No	1	1	1	1
* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. ($\text{pfu} = \text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons ($\geq 2\text{MeV}$)

Electron flux at GOES16 has been reaching high levels at the diurnal maximum, with fluence now just above the Active ($1\text{e}8$ integrated pfu) threshold. The recent high speed stream (HSS), giving elevated to strong solar wind speeds, and associated geomagnetic activity has caused electron charging within the Van Allen belts. It is possible that the charging below GEO is higher still, with this being indicated by the BAS radiation belt model. There is the potential for an increase in flux as the wind speed associated with the current HSS eases and the Van Allen belts relax, allowing the increased electron flux levels to move towards GEO. However, any glancing CMEs could cause a drop out in electron flux, although this is low confidence and the most likely situation is that flux will continue reaching high levels at the diurnal peaks through the next few days.

Electron fluence is likely to remain above Active during the next few days, perhaps with a slight rising trend. MOSWOC REFM is giving reasonable guidance, although is too high with the overall values.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^8$	No	100	90	80	70
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times 10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM, showing fluence above the Active level. REFM is forecasting a continuation of this which is considered reasonable guidance, although overall values are too high.

